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Exploring costs and benefits of compliance with HACCP regulation in the European meat and dairy sectors¹

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Abstract

A Hazard Analysis and Critical Control Point (HACCP) Program was introduced as a mandatory measure in the EU in the 1990s. Despite its impact on the food industry, only limited literature addresses the issue of cost and benefits of HACCP at the firm level in Europe. This paper illustrates the results of a pilot study on case studies in Italy, UK and The Netherlands, providing a first assessment of the order of magnitude of costs of compliance and a qualitative illustration of the main benefits perceived by producers.

Keywords: *Regulatory impact assessment, HACCP, food industry.*

Introduction

In the last few years food safety issues have been debated more and more widely across the EU. Recent food scares have given rise to a demand for regulations able to guarantee healthy food to consumers and to prevent food-borne diseases.

Public agencies involved in food safety regulation need information about costs and benefits of the measures to be implemented, in order to assess the impacts on welfare and improve the fine tuning of the policies. Although it is generally agreed that market failures in providing safe foods should be corrected, there is still debate on the relative weight to assign to mandatory versus incentive based schemes (Segerson, 1998).

During the 1990s, Hazard Analysis and Critical Control Point (HACCP) systems have been introduced as mandatory measures in the food industry although it was already a prerequisite to access certain food markets, often embedded in more comprehensive voluntary quality systems¹ (such as: ISO 9002, BRC standards and product certifications schemes). Costs and benefits of HACCP systems

have been the object of many studies in the USA (Golan et al., 2000; Unnevehr, 2000). However, apart from some exploratory research (Henson et al., 1999), there is actually little systematic information to support policy assessment at the European level.

This paper presents the preliminary results of a pilot study aiming at testing a suitable methodology for the assessment of the economic impacts of firm compliance to HACCP regulation in the meat and dairy sectors across three EU countries (Italy, United Kingdom and the Netherlands) and at providing a first estimate of the order of magnitude of costs of compliance as well as a qualitative appreciation of perceived benefits. The work is based on a series of 11 case studies that provided both quantitative and qualitative data at firm level.

The structure of the paper is as follows. After a short discussion of the main issues concerning the analysis of costs and benefits of food safety at the firm level (section 2), the data collection process is illustrated (section 3). Then, the main findings of the analysis of HACCP compliance costs as well as of the perceived benefits at the firm level are discussed (section 4). Finally, concluding remarks and some suggestions of possible improvements of the HACCP systems are reported (section 5).

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Analysing costs and benefits of food safety regulation at the firm level

A growing literature has recently been developed on the application of Regulatory Impact Analysis (RIA) to food safety regulation. Such a trend reflects not only a growing awareness among governments of the need to improve efficiency and transparency of the regulation process, but also the increasing attention paid by consumers to food quality and safety issues (Antle, 1999). Costs and benefits of the introduction of food safety standards have been analysed in several papers (see, for example, MacDonald and Crutchfield, 1996; Segerson, 1998; Antle, 1999; Henson & Caswell, 1999; Belzer, 2000). Issues discussed in these papers include among others the identification of costs and benefits and their assessment. Different typologies of costs and benefits deriving from the introduction of a food safety regulation can be identified, according to the stakeholder (firm, consumers and public bodies) involved in the implementation of HACCP. Carrying out a complete RIA would require the assessment of all listed items using different methodologies (Antle, 1999). However, the scope of this study is narrower as it will deal only with costs and benefits of HACCP at the firm level.

As far as the estimation of costs at the firm level is concerned, Antle (1999) lists three alternative approaches that, under proper assumptions, can be used: (a) accounting methods, (b) economic-engineering methods, and (c) econometric modelling. In this study we employed the accounting approach as it simply entails identifying and assessing capital and labour actually used to implement and manage the system, without specifying any cost function. On the one hand the main advantage of this method is its relative simplicity, due to the nature of the required data (although they may not be so easily available at the plant level). On the other hand, this approach may require large and expensive surveys when a large variability of plant technology exists and it does not provide any assessment of the impact of regulation on firm efficiency.

Notwithstanding these drawbacks, several examples of application of the accounting approach to the estimation of costs of compliance to different norms and regulations have been recently published with reference to HACCP (Zugarramurdi et al., 2000; Cato & Dos Santos, 2000; Colatore & Caswell, 2000; Nganje & Mazzocco, 2000), ISO 9002 (Canavari & Spadoni, 2003) and traceability (Mora & Menozzi, 2002).

In contrast to the costs, at the firm level the assessment of benefits of compliance has often been carried out in a qualitative way. In fact, only savings

due to the decrease of failure costs (mainly related to disposal of output that does not meet the required standards) can be easily assessed within the accounting approach (Zugarramurdi et al., 2000; Canavari & Spadoni, 2003). While the assessment of benefits from marketing and/or efficiency improvements appears to be more uncertain.

An exploratory survey, based on a qualitative analysis has been proposed by Henson and Heasman (1998) for the UK dairy sector. The difficulties in assessing benefits depend mainly on the dynamic nature of the complying process (Henson & Heasman, 1998). In addition, the responses of firms to food safety legislation are of a strategic nature (Loader & Hobbs 1999), depending on the structure of incentives towards adoption of voluntary standards or compliance with mandatory ones (Holleran et al., 1999). Thus the creation of Quality Assurance Systems, the achievement of certification (such as ISO or BRC) and the compliance with food safety regulations have often been carried out jointly, within an overall process of firm reorganization. Moreover, these changes often take place in the occasion of rapid upsurge of sales and market shares, thus making problematic a proper allocation of benefits to the process of compliance alone.

Data collection

This study is based on a series of case studies carried out to obtain a first assessment of the magnitude of costs and benefits in two different sectors (dairy and meat processing) and to test the accounting approach method in view of a more comprehensive study. The research was part of a EU funded project and covered three member countries (namely Italy, UK and the Netherlands)². Altogether 11 plants (6 for the meat sector and 5 for the dairy sector) were investigated. Although the plants were chosen in order to represent different plant sizes and business types (from family run businesses to large corporations), the case study design cannot provide representative estimates. As was stated above, the aim of the study is rather to test the suitability of the methodology and to provide a first assessment of the magnitude of cost and benefits³. The main characteristics of the sample are illustrated in Table I.

Following an exploratory design, the research was based on in-depth interviews with managers involved in the compliance process (usually a Quality Assurance manager and a member of the cost control staff) whereby accounting data, as well as answers to open questions on costs and benefits, were collected.

A special effort was devoted to achieve a better understanding of the compliance process followed

Table I. Main economic and production characteristics of the selected case studies.

Label (*)	Firm size (**)	Employees (number at plant)	Type of products	Other characteristics
IT-1D	Medium	206	Fresh dairy	Municipality owned business
IT-2D	Small	63	Speciality fresh and long life dairy	Shepherds' cooperative
IT-1M	Medium	187	Salami, ham and others	Private company
IT-2M	Medium	297	Premium cured ham	Mother company of a large group
NL-1D	Large	500	Long shelf life dairy	Plant of larger firm
NL-2D	Large	150	Fresh dairy	Plant of larger firm
NL-1M	Large	350	Fresh meat	Plant of larger firm
NL-2M	Large	110	Bacon	Plant of larger firm
UK-1D	Small	50	Speciality fresh dairy	Family run business
UK-1M	Small	20	Bacon curer	Family run business
UK-2M	Large	320	Frozen meat preparations	Part of a large group

*Country, number, D = Dairy, M = Meat processing. **Firm size categories based on turnover: Small (turnover ≤ 50 Mio €), Medium (100 $>$ turn. > 50 Mio €), Large (turn ≥ 100 Mio €).

by the companies or plants and to describe the nature of the related costs (such as investment in fixed assets vs. current maintenance costs or labour vs. direct costs). This called for a considerable effort in constructing a friendly collaboration with the interviewed managers and required several meetings to complete the data collection. Available accounting data from financial statements were used as well. While it was possible to provide a quantitative estimation of costs of compliance, benefits were assessed only in a qualitative way, a quantification at firm level being problematic, as was stressed in the previous section.

The main problem in reconstructing HACCP costs resulted from the considerable time lag between the implementation of the system and the period the study was carried out. For example, in the Italian case, even though the 1993 CE directives concerning food hygiene were acknowledged by national norms only from 1997 onwards, many companies started to comply before that date⁴. This implied that interviewed managers had to recollect past data and make some estimates. Moreover, HACCP often is embedded in more comprehensive quality systems such as ISO or BRC and this entails disentangling costs related to HACCP from joint costs shared with quality systems.

Different definitions of costs of compliance have been used in the literature. Colatore and Caswell (2000) distinguish between: (a) total cost (cost of actual HACCP system adopted by a firm), (b) minimum HACCP cost (costs necessary to meet the mandatory requirements), and (c) incremental cost of HACCP due to compliance with the regulation (the minimum costs net of voluntary adoption of HACCP). The first definition was adopted in this work in order to keep the complexity of the questionnaire to an acceptable level⁵.

The elicitation of HACCP costs followed an "activity based" approach. First costs were classified as start up (design development and implementation of the system) and maintenance costs, then the latter were further subdivided according to the "Prevention-Appraisal-Failure" (PAF) framework (Zugarramurdi et al., 2000). Prevention costs refer to actions taken to investigate, prevent or reduce defects and failures, while appraisal costs are made to assess and record the achieved level of quality. Conversely, failure costs arise from failure to achieve the specified quality (recalls, liability costs, etc.). According to the PAF framework, the share of failure costs is inversely related to the level of quality: when the failure costs share is high the output quality is low while it decreases gradually as far as prevention and appraisal actions are carried out and the quality of output increases.

The amount of capital and labour (hours) required to carry out those activities was estimated by interviewing firm managers. Labour requirements were broken down by employee categories such as blue collar, technical staff and management. Subsequently, labour costs were quantified multiplying labour time by category specific hourly wages.

In the analysis, costs for the start up phase were annualized at a standard depreciation rate (10%). The resulting (annualized) start-up cost was then added to maintenance costs. Finally, the overall cost figures were normalized with reference to either turnover or physical output, to allow meaningful comparisons between plants and sectors.

Results

HACCP costs

One of the objectives of the research was to provide a first assessment of the magnitude of costs of

compliance for the HACCP regulation. Tables II and III show some figures concerning the case studies investigated in the dairy and meat processing sectors. The total cost of compliance roughly ranges from 0.7 to 3% of turnover. The data on the cases in dairy show large differences in the cost of compliance in large Dutch plants compared to smaller Italian plants. As the value added per kg of raw milk differs between products, this could be expected in expressing the costs per kg of raw material. However it seems also the case in a percentage of turnover, possibly suggesting economies of scale in implementing HACCP and penalizing small producers.

Although the research design, i.e., in-depth interviews on a limited number of cases, does not support the use of statistical inference, a different pattern between the two sectors can be noticed: dairy firms seem to be characterized by lower average HACCP costs per unit of raw material and by higher incidence of HACCP costs on turnover. This can be attributed to a lower ratio of value added on turnover in the dairy sector, highlighting a source of incomparability that should be taken into account when performing similar studies across food industry sectors.

It is possible to compare the figures obtained with estimates referring to the US meat sector (Table IV). US cost estimates were based on larger surveys but still show large variability and uncertainty. However US data appear to be of the same order of magnitude than those resulting from this study.

In addition, the accounting methods that were employed in this study can provide an assessment of the importance of the different cost categories (Tables II and III). As a first approximation the start up and maintenance costs can be singled out. Annualized start-up costs (calculated at 2002 prices and annualized at 10% depreciation rate) are a minor component of the annual HACCP total cost for the investigated case studies, being always below 0.15% of turnover. Their variability across cases probably depends on the different level of advance-

ment of the business before the implementation of the system as firms already quality-oriented needed less effort to comply with HACCP standards. Conversely data don't show a clear relationship between start-up costs and business size.

However even if start up costs could be of interest when assessing the burden imposed on the productive system by a new regulation, it is clear that its impact on the current cost of production is less important than the impact of maintenance costs. The incidence of these costs on turnover roughly ranges between 0.5 and 3%⁶. Preventive and appraisal⁷ efforts (such as sanitation controls) are the most important components of HACCP cost. This pattern is consistent with the HACCP approach to food safety: a rationalization of production yielding to a reduction of costs related to safety failure associated with higher costs for quality assurance.

In order to gain a better insight into how the methodology allows researchers to analyse different cost categories and their patterns of variation across plants, the rest of this section will feature a more in depth analysis limited to the four Italian case studies.

Table V illustrates start-up costs of the HACCP system in the Italian case studies. Costs can be broken down into different categories: those relating to the system set-up, design and development phase and those concerning implementation, the latter being further subdivided into investment, manual drafting and other implementation costs.

The structure of HACCP start-up costs seems to be quite different between the cases. As it was stated before, differences in the relative weights of each component may be attributed to the state of internal quality control when the HACCP system was implemented. Thus, in the IT-2M case, due to the nature of production (premium quality cured ham), specific investments in fixed assets were not necessary, while pre-existing hygienic control procedures only needed to be rationalized and defined in a formal way: consequently, the main item of start-up

Table II. HACCP costs of compliance in the dairy sector.

	Case studies – Dairy					Average
	IT-1D	IT-2D	NL-1D	NL-2D	UK-1D	
Firm size	Medium	Small	Large	Large	Small	
HACCP costs of compliance (in €/ton raw material)	34.40	37.10	3.69	4.51	15.40	19.02
Breakdown (in % of turnover)						
Start-up costs	0.05	0.09	0.05	0.09	^a	0.07
Maintenance costs	2.91	1.88	0.62	1.01	3.02	1.89
Total costs	2.96	1.97	0.67	1.10	3.02	1.94

^aNo data available.

Table III. HACCP costs of compliance in the meat processing sector.

	Case studies-Meat processing						Average
	IT-1M	IT-2M	NL-1M	NL-2M	UK-1M	UK-2M	
Firm size	Medium	Medium	Large	Large	Small	Large	
HACCP costs of compliance (in €/ton raw material)	52.30	171.90	20.75	23.65	. ^a	42.81	62.28
Breakdown (in % of turnover)							
Start-up costs	0.06	0.01	0.12	0.09	0.08	0.15	0.08
Maintenance costs	1.23	1.83	2.37	0.77	1.65	1.52	1.56
Total costs	1.29	1.84	2.49	0.86	1.73	1.67	1.65

^aNo data available.

costs concerns the design and development phase (78%). Conversely, IT -1M presents a significant share of investment in fixed assets, namely adjustment of product lines through the introduction of a computerized temperature control system in the production process critical points.

The same applies to the other two case studies. IT-2D was a relatively new plant (four years old), therefore costs are mainly due to the formalization of HACCP procedures. On the other hand IT-1D presents more or less the same costs for design and development efforts (design of a fully computerized internal information system) and investment (improvement of the construction, e.g., new plant floors, etc.).

Also maintenance costs of the HACCP system have been broken down into different categories: prevention, appraisal and correction of failures, the last being allocated to internal (such as reworking) and external actions (such as product recalls).

First of all, data indicate that actions directed to prevent a deviation from the HACCP standards (prevention and appraisal) accounts for more than 75% of the operation costs of the system, with prevention costs showing the largest share, though with a different relative weight across cases. Different patterns seems to characterize the two sectors: the two meat processing firms focus more on prevention costs, where the two dairy firms devote a significant effort to appraisal (e.g., laboratory analysis).

Table IV. Average cost for HACCP compliance in the meat sector: A comparison with US data.

	HACCP cost estimates (€/ton)		
	minimum	average	maximum
Nganje and Mazzocco (2000)	0.9	55.1	943.6
Hooker et al. (2002)	39.7	95.5	396.8
Our estimates	20.8	62.3	171.9

The adopted currency exchange rate was 1.2 US \$ per Euro. US estimates were recalculated at 2002 prices.

Moreover, the two larger companies (IT-1D and IT-2M) show a significant share of costs relating to internal failure. In the first case the nature of fresh dairy production excludes reworking, that means that faulty products have to be discarded. In the second case, internal failure costs (mainly withdrawals and reworking) can be explained by the firm's attempt to achieve very high qualitative standards. External failure costs in the meat sector refer mainly to product liability insurance. A significant cost for products recalls was reported only in the IT-1D case and it depends, once again, on the nature of its products (fresh milk).

HACCP benefits a qualitative assessment

The in-depth interviews provided some qualitative insights about a range of benefits that managers ascribed to the introduction of the HACCP system. When it was first introduced, HACCP was used also to gain market shares and to differentiate from competitors (as was the case for UK-2M). Now in all cases the implementation of the system is considered just a regulatory and commercial prerequisite to access markets. The effectiveness of food safety risks prevention is a standard requirement demanded by all customers operating downstream along the food chain. The evidence of system failures above a given threshold (normally considered as acceptable by customers) would translate into lack of trust and would quickly cause significant losses of market share. In fact, HACCP is always seen as a tool to reduce the business risks (this is even more important in countries such as the UK where a due diligence defence legislation is in place) facing a market that is increasingly more concerned about food safety risks, whether real or not. Conversely, voluntary forms of certification-as ISO 9002 and traceability-are often considered as marketing tools to access new markets or clients.

Table V. Structure of start-up costs and of operational costs by category (%) for the Italian case studies.

Cost categories	Case studies			
	IT-1D	IT-2D	IT-1M	IT-2M
Start-up costs				
Set-up, design and development	33.94	39.12	16.61	78.38
Investment	35.55	6.10	40.25	0.00
Manual and communication	1.65	40.51	29.66	4.34
Other*	28.86	14.27	13.48	17.29
Total start up costs	100.00	100.00	100.00	100.00
Operational costs				
Prevention	44.53	64.14	83.37	74.22
Appraisal	35.30	31.92	11.85	2.25
Internal failure	16.81	0.41	0.77	16.95
External failure	3.36	3.53	4.01	6.58
Total operational costs	100.00	100.00	100.00	100.00

*Other costs include any specific other costs related to the design and development of HACCP (such as specific computer programs, computers etc.).

In the Italian meat processing cases, managers made an explicit reference to a significant decrease of required corrective actions, concerning both outputs returned by clients and the internal checking of lots not fitting the minimum standard. Managers emphasized that this led to the improvement of the efficiency of the production process.

Both validation procedures and revisions of the HACCP manuals were conducive to non trivial gains in terms of costs-effectiveness. Organizational solutions and technical devices introduced as a part of the HACCP implementation actually improved the quality of production, using the same amount of resources (labour and materials): for example a better coordination of the teams of workers operating the programmed hygiene measures, or the substitution of laboratory analysis and controls with monitoring of execution time of tasks that are characterized by relevant risks of microbial nature. The emergence of *learning by doing* processes as a consequence of HACCP implementation was stressed in all cases: this led to significant improvements of efficiency through a better firm organization (reduction of costs and/or increase in productivity).

A third category of benefits, attributable to the HACCP monitoring routines, relates to the development of workers/employees skills. Sooner or later, in most firms a more or less structured Quality Assurance team was appointed.

The last category of benefits refers to better circulation of information within the firm. The HACCP implementation usually extends to the whole organization the commitment for information gathering, data assessing and systematic registration

of collected information. As a consequence, effective procedures of information transmission are needed. In two Italian cases specific investments were made in the improvement of the internal information system. The set-up of an efficient network for internal communication between management and technical staff can be used for more purposes than food safety only, improving the overall firm efficiency.

However, managers showed also several concerns about the current performance of the system. The main concern that arose was about the non-homogeneous interpretation of HACCP norms by different authorities involved in supervising the system. This problem seems to affect both the national and the EU level. At national level, for instance, the supervision of different plants owned by the same company is often in charge of different local authorities: the subjective interpretation of norms by different officials led to different compliance prescriptions for each plant, though they were managed according to a single set of intra-firm guidelines. There were also complaints about the non homogeneous interpretation of HACCP regulation across member countries, raising problems in terms of access to foreign markets and competition within the EU single market.

Thus a need for a more standardized approach to compliance came forward. According to some interviewees, standardization could be improved by putting in place check-lists agreed by both public officials and companies or by implementing uniformly designed training courses for both private companies and public body's staff.

Overall it seems that a balance should be achieved between a welcomed flexibility of the system and the need for more harmonization. On the one hand, the possibility of adapting the system to different production contexts improves its cost-effectiveness imposing less burden on the business. On the other hand, excessive flexibility jeopardizes the achievement of proper food safety levels and leads to uncertainty and unfair market competition.

Conclusions

Although the impact of HACCP on the food industry is expected to be relevant, not much literature addresses the issue of cost and benefits of HACCP at the firm level in Europe. A first result of this study is that the developed methodology has shown to be suitable for use in a wide range of production plants. Even if most plants could not provide specific accounting data on HACCP costs, in-depth interviews with key managers were effective in providing estimates of costs of compliance. In particular, the use of an activity based approach to break down costs into categories more easily understood by managers and the assessment of labour costs multiplying labour time by hourly wages, proved to be a rather effective way to estimate costs of compliance even when such cost referred to past years.

In the investigated plants, observed costs of compliance for the HACCP regulation roughly range from 0.7 to 3% of turnover, following sector specific patterns. Overall, both order of magnitude and variability of estimates are comparable with published USA data for the meat sector. However, the diversity of costs found in this study is likely to be even greater in practice, given the broad nature of the pan-European food manufacturing industry ranging from family run business to large multinational companies.

HACCP was widely considered as a necessary and justifiable cost that brings some important benefits as well. The benefits were reported as higher value market shares, improvement of staff skills, reduced costs of failure, etc. However, HACCP implementation poses some concerns that arise mainly in the perceived differences in its compliance between similar businesses and countries. In conclusion, the proposed methods for collecting data on HACCP cost of compliance seem a promising one. Further research should be carried out on a wider sample in order to provide results with greater external validity and allow EU policy makers to perform a sounder regulatory impact assessment for HACCP.

Notes

1. This was the point of view of most managers of the plants investigated in this research (see below).
2. Detailed results of this project, covering a number of issues besides economic analysis, are illustrated in Van der Kamp et al. (2004).
3. However, this is not an uncommon practice in the area of cost assessment of HACCP. In 1996 the Food Safety Inspection Service (FSIS) of the US Department of Agriculture performed its economic assessment of the HACCP for meat and poultry sectors basing its cost estimates on data collected from only nine plants (Antle, 1999).
4. Actually meat processing plants had to implement HACCP like standards before 1997 to comply with Directive 92/5 CEE on health problems affecting intra-Community trade in meat products.
5. It is worth noticing that total costs are always greater or equal than minimum costs and incremental costs. However, they cannot be defined as an upper bound of the other two categories since each type refers to a different cost concept.
6. Due to the small number of cases, in order to obtain a meaningful comparison, the degree of effectiveness of HACCP systems was also assessed in every investigated plant in each country. A summation scale was built assigning a score to 12 different features of the system. The list of features was derived from a standard compiled by the Dutch National Board of expert-HACCP. No clear relationships seems to exist between incidence of HACCP costs on turnover and the effectiveness score while only a weak positive correlation (0.2) between cost per ton and effectiveness was found. Details on the methodology followed in building the scale can be found in Van der Kamp et al. (2004).
7. Appraisal costs are costs that derive from sampling, inspection and test actions performed to evaluate if the level of pre-determined quality is maintained (Zugarramurdi et al., 2000).

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